Picture of the Week: Hacking the bio-nano interface for better biofuels

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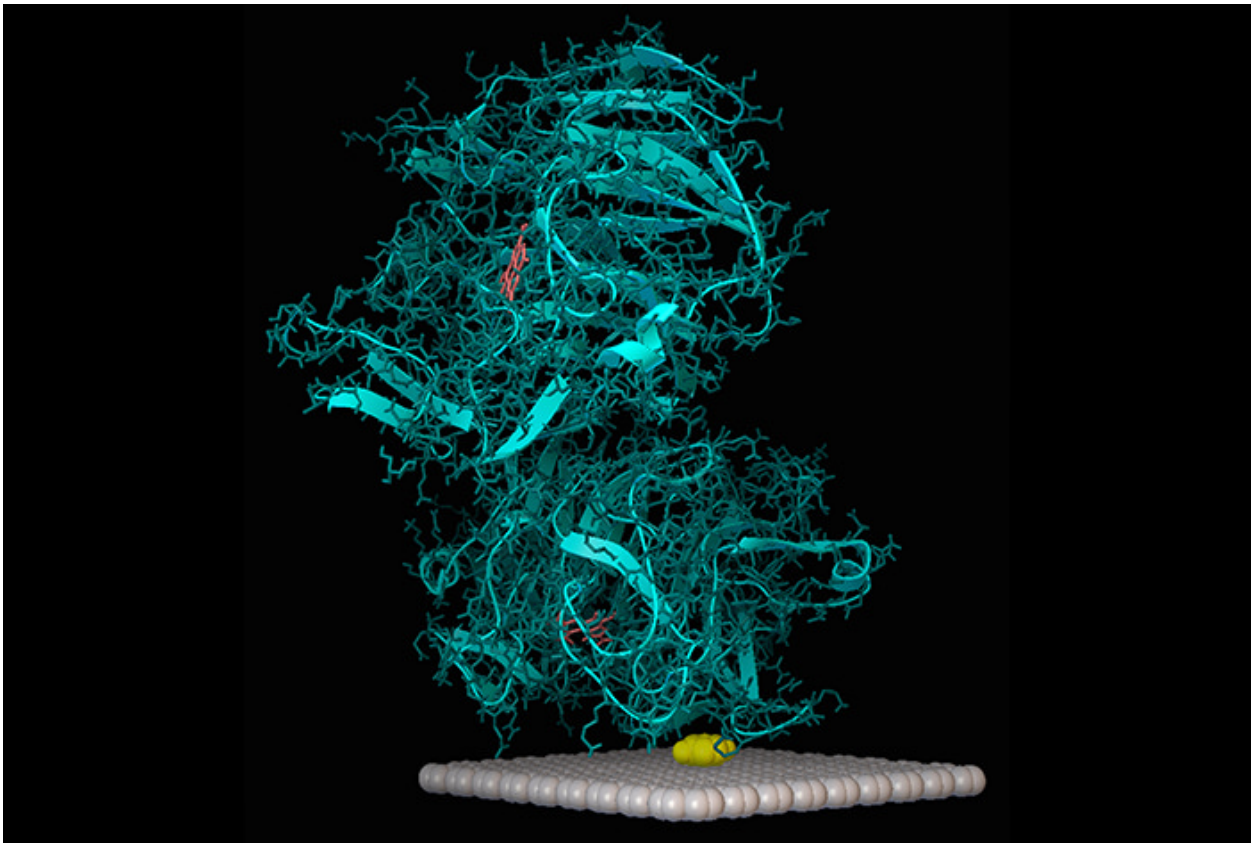

Hacking the bio-nano interface for better biofuels

At Los Alamos National Laboratory, theoretical physicists and chemists are using computers to develop more efficient ways of converting biofuels into electricity by using fuel cells. Fuel cells generate electricity by using enzymes from microorganisms as a catalyst to oxidize cheap and abundant fuels, such as sugars. While the approach shows great promise, the slow rate of electron transfer where the enzymes meet the electrodes at the bio-nano interface limits fuel-cell performance. To address that problem, Los Alamos scientists use computers to model the process and find ways to improve it. Recent models have studied how three quinones (a class of organic compounds) influence electron transfer between the enzyme and the electrode to determine the best placement of enzymes on the electrode's surface. These simulations help electrochemists develop bio-fuel cells that generate more current and thus produce more electrochemical power.

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In this image you can see the different elements involved in this bio-nano interface approach. The gray region is the model of an electrode. The blue region is the enzyme, or bio-catalyst. The yellow is a quinone used to modify the electrode surface to orient the enzyme on the electrode and achieve enhanced electron transfer from the enzyme to the electrode. The pink region is the PQQ cofactor (electrons are transferred from the fuel—in this case glucose—to PQQ and then to the electrode).

The work depicted in the image was done in collaboration between University of New Mexico and Theoretical Division, Physical and Chemistry of Materials group at Los Alamos National Laboratory and was published in the Journal of American Chemical Society (S. Babanova, I. Matanovic, M. S. Chavez, and P. Atanassov, Role of Quinones in Electron Transfer of PQQ-Glucose Dehydrogenase Anodes – Mediation or Orientation Effect. *J. Am. Chem. Soc.* 137, 7754-7762 (2015).

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